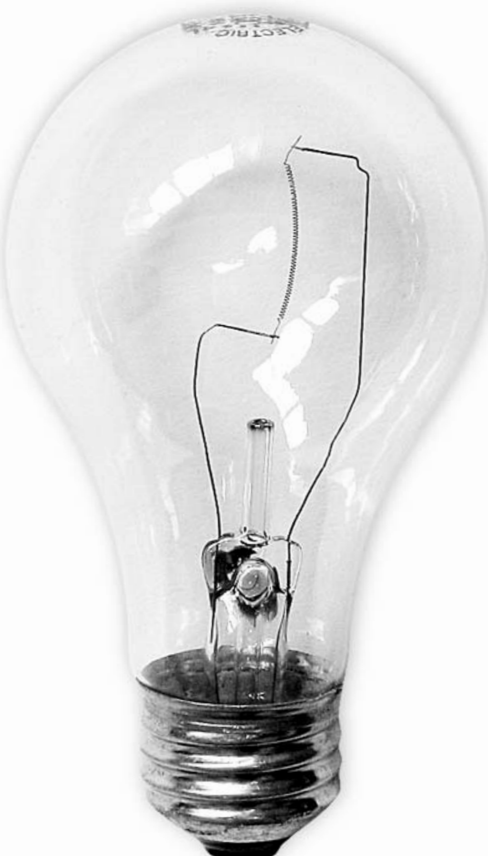
MIND HACKS™

Tips & Tools for Using Your Brain



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Foreword by Steven Johnson, author of Mind Wide Open

HACK #17 Glimpse the Gaps in Your Vision

Our eyes constantly dart around in extremely quick movements called saccades. During each movement, vision cuts out.

Despite the fact that the eye has a blind spot, an uneven distribution of color perception, and can make out maximal detail in only a tiny area at the center of vision, we still manage to see the world as an uninterrupted panorama. The eye jumps about from point to point, snapshotting high-resolution views, and the brain assembles them into a stunningly stable and remarkably detailed picture.

These rapid jumps with the eyes are called *saccades*, and we make up to five every second. The problem is that while the eyes move in saccade all visual input is blurred. It's difficult enough for the brain to process stable visual images without having to deal with motion blur from the eye moving too. So, during saccades, it just doesn't bother. Essentially, while your eyes move, you can't see.

In Action

Put your face about 6 inches from a mirror and look from eye to eye. You'll notice that while you're obviously switching your gaze from eye to eye, you can't see your own eyes actually moving—only the end result when they come to rest on the new point of focus. Now get someone else to watch you doing so in the mirror. They can clearly see your eyes shifting, while to you it's quite invisible.

With longer saccades, you can consciously perceive the effect, but only just.

Hold your arms out straight so your two index fingers are at opposite edges of your vision. Flick your eyes between them while keeping your head still. You can just about notice the momentary blackness as all visual input from the eyes is cut off. Saccades of this length take around 200 ms (a fifth of a second), which lies just on the threshold of conscious perception.

What if something happens during a saccade? Well, unless it's really bright, you'll simply not see it. That's what's so odd about saccades. We're doing it constantly, but it doesn't look as if the universe is being blanked out a hundred thousand times a day for around a tenth of a second every time.

> Saccadic suppression may even be one of the ways some magic tricks work. We know that sudden movements grab attention [Hack #37]. The magician's flourish with one hand grabs your attention, and as your eyes are moving, you aren't able to see what he does with the other hand to pull off the trick.
>
> —N.H.

How It Works

Saccadic suppression exists to stop the visual system being confused by blurred images that the eye gets while it is moving rapidly in a saccade. The cutout begins just before the muscles twitch to make the eyes move. Since that's before any blur would be seen on the retina, we know the mechanism isn't just blurred images being edited out at processing time. Instead, whatever bit of the brain prepares the eyes to saccade must also be sending a signal that suppresses vision. Where exactly does that signal come from? That's not certain yet.

One recent experiment proves that suppression definitely occurs before any visual information gets to the cortex. This isn't the kind of experiment that can be done at home, unfortunately, as it requires *transcranial magnetic stimulation* (TMS). TMS [Hack #5] essentially lets you turn on, or turn off, parts of the brain that are close enough to the surface to be affected by a magnet. The device uses rapid electromagnetic pulses to affect the cells carrying signals in the brain. Depending on the frequency of the pulses, you can enhance or suppress neuronal activity.

Kai Thilo and a team from Oxford University[1] used TMS to give volunteers small illusionary spots, called phosphenes, in their vision.

When phosphenes were made at the retina, by applying TMS to the eye, saccadic suppression worked as normal. During a saccade, the phosphenes disappeared, as would be expected. The phosphenes were being treated like normal images on the retina. But when the spots were induced later in visual processing, at the cortex, saccades didn't affect them. They appeared regardless of eye movements.

So, suppression acts between the retina and the cortex, stopping visual information before the point where it would start entering conscious experience. Not being able to see during a saccade isn't the same kind of obstruction as when you don't see because your attention is elsewhere. That is what happens during change blindness [Hack #40]—you don't notice changes because your attention is engaged by other things, but the changes are still potentially visible.

Instead, saccadic suppression is a more serious limitation. What happens during a saccade makes it nowhere near awareness. It's not just that you don't see it, it's that you can't.

End Note

1. Thilo, K. V., Santoro, L., Walsh, V., & Blakemore, C. (2004). The site of saccadic suppression. *Nature Neuroscience,* 7(1), 13–14.

See Also

- Saccadic suppression also lies behind the stopped clock illusion [Hack #18].